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ABSTRACT

Ten mother-infant dyads were observed in their homes for four hours each during one month in order to measure interactive aspects of their behavior. Demographic data are included for the participating families, who are members of the Wolof in Senegal, Africa. For this study, interaction was defined as a sequence of behaviors involving both caretaker and infant which fell (a) within one 10-second time column or (b) extended over two or more time columns but which the observed judged to be a continuous sequence. Six different infant behaviors (fret/cry, extreme movement, look, vocalize, smile, touch) and five adult behaviors (touch-gross, touch-fine, vocalize, smile, approach) were recorded. After collecting the observational data, the new Bayley Scales of Infant Development were given to the infants in their homes. The most important result to emerge was that the pattern of caretaker-infant interaction was related more strongly to the age of the infant than to any other variable investigated. The results of the developmental testing are in agreement with other findings that African infants show precocious development within the first year. No relationship between the interaction measures and tests of cognitive and motor skills was found. (Author/NH)

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MOTHER-INFANT INTERACTION AND INFANT DEVELOPMENT AMONG THE WOLOF OF SENEGAL

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In the past two decades, considerable evidence has been presented to show that environmental conditions can influence the rate of development of children; in particular, unstimulating environments may have a retarding effect on the growth of infant abilities (Dennis, 1960; Dennis & Dennis, 1941; Dennis & Najarian, 1957; Provence & Lipton, 1962; Spitz, 1945; Yarrow, 1961). Gebér (1956, 1958a, 1958b, 1960), Gebér and Dean (1957a, 1957b) and Ainsworth (1967) have recently reported studies of African infants which suggest that the opposite effect is also possible: certain environmental conditions may accelerate the rate of development.

Gebér found precocious development, as measured on the Gesell Developmental Schedules, common and particularly marked in the first year of life among 252 infants examined in and near Kampala, Uganda. Locomotor development--sitting, crawling, standing, walking--was most accelerated, but all aspects of development were precocious, including language, prehension and manipulation, adaptivity and personal-social behavior. Ainsworth (1967), working with the Griffith Infant Intelligence Scale, reported similar findings for her Ganda sample of 28 infants.

Gebér's (1960) comparative study of highly acculturated (westernized) and traditional village families indicated that the kind of infant care provided in the two settings was largely responsible for differences in rate of development. Infants in highly acculturated families failed to exhibit the precocity of development during the first year of life evident in the infants of

traditional families. Infants of acculturated families tended to be kept in cribs much of the time, rather than participating regularly in the family circle as is the case in the traditional setting. They were held and carried much less often than the village infants, and fed on schedule rather than on demand. Gebér concluded, and Ainsworth supported this interpretation, that caretaking conditions peculiar to the traditional home were largely responsible for the differences in rate of development. This conclusion is in line with several other theories which postulate the importance of caretaker-infant interaction for the development of cognitive and motor abilities (Bowlby, 1958; Gewirtz, 1966; Hunt, 1963; Lewis & Goldberg, 1969).

Due to the nearly constant presence of mother (or mother substitute) with the infant in traditional African homes, there is an extremely high incidence of interaction between them. On this count, it is a setting unusually well suited to the exploration of caretaker-infant interaction as a consequence of such variables as age, sex, family size, and nature of the caretaker. Moreover, the setting also provides an opportunity to replicate the finding of African infant precocity and at the same time relate this precocity to individual differences in the caretaker-infant interaction.

Method

The Locale

The study was conducted among the Wolof of Diourbel, Senegal. Diourbel is a middle-sized town about 90 miles directly inland east of Dakar. It is part of Senegal's peanut belt, in the heart of territory originally and most densely settled by the Wolof. The latest census (1960) reported the town's population to be around 40,000. This number is deceptive, however, as the

population is spread out over a large territory which includes farmlands and isolated hamlets. As a regional capital, Diourbel has several primary and secondary schools, a large market, highway and railway connections with Dakar, and small French and Lebanese populations. However, due to the self-imposed isolation of these foreign communities, none of the African families visited had ever before entertained a white person in their home. French is spoken in the schools and regional offices, but Wolof is the language of the streets and small stores. Men tend to have at least a working knowledge of French; none of the women visited spoke French. In spite of its size, relative lack of isolation, and visible exposure to modernization in the center of town, the population of Diourbel, especially the women and young children with whom the research was concerned, is not highly acculturated. The daily life of women and children not attending school is relatively unaffected by modernization; several children in families visited had never seen a white face; native remedies vie with and win over modern medicine, and superstition is prevalent and strong, blending comfortably with Islam.

The Sample

Obtaining the sample and enlisting cooperation required individual introductions to households. With the exception of one household, contact was made through a friend, relative, or neighbor of the family. The introductions were usually made by secondary school students, met through a Peace Corps teacher, or by members of families already contacted.

The sample for which the data are complete was composed of ten infants. Their demographic data are presented in Table 1. Although an attempt was made to select an unbiased sample, the families do have a higher educational background than is normally found in the community. The sample included one pair of fraternal twins, and one other child also had a twin who subsequently died.

Insert Table 1 about here

Procedure

Observational Data

Observational data on all infants were collected in one month. Each infant was observed in his own home with as little disturbance of the family routine as possible. Each family had received from five to ten visits from the observer (D.L.) prior to the first formal observation session. During the course of these visits, the prospective work was explained to the family in Wolof, and they became habituated to the presence of the observer and the use of pen and paper during the visit. The family was told that the observer had heard that African infants "grew up faster" than American infants, and that she had come to see if this were true. The "writing" was necessary so that nothing would be forgotten and so that there would be "a way to show" people what the life of a Senegal infant was like.

The observation sessions were intended originally to last full mornings and afternoons, but this did not prove practical. The families' tolerance for the sessions was definitely finite and only once did a session exceed 90 minutes. The observational data on each infant derived from several such short sessions, collected as close in time to each other as possible. A total of approximately four hours was collected for each subject.

All observations were recorded on sheets divided into ten-second time columns. Six infant and five adult behaviors were recorded--for infants: fret/cry, extreme movement (thrashing, kicking, arm-waving), look, vocalize, smile, and touch; for adults: touch-gross (rock, bounce, toss, etc.), touch-fine (pat, kiss, stroke, etc.), vocalize, smile, and approach. These behaviors were recorded in sequence, each behavior receiving a number according to its

order of occurrence within a ten-second time column. This type of data sheet has been used in similar studies using American infants (see Lewis & Goldberg, 1969, and Lewis, 1971).

After the observational data had been collected for each family, the new Bayley Scales of Infant Development were given to each infant. The mother was told that the observer wished to see how the infant played; American children played with similar things, and the observer wished to know if African children played the same way. The scales were administered in the home in order to insure that both mother and infant would react principally to the test stimuli rather than to the novelty of strange surroundings. Although this procedure deviated from the prescribed setting for administering the Bayley Scales with respect to its lack of isolation, it is believed that it enhanced rather than jeopardized the validity of the results. Household members did not interfere with the testing, and the familiarity of the setting helped to relax both mother and infant. No special equipment was used, with the exception of some wooden replicas of toys as required by the Bayley Scales.

Measurement

In the study of the relation between infant and mother or her substitute, it is important to measure the interactive aspects of behavior rather than merely the number of responses each member of the dyad performs. For the purposes of this study, interaction was operationally defined as follows: a sequence of behaviors involving both caretaker and infant which fell (a) within one ten-second time column or (b) extended over two or more time columns but which the observer judged to be continuous sequence. All behaviors which did not occur during such a sequence were considered noninteractive. Total behavior is the sum of all interactive and noninteractive behavior. Specific behaviors as well as overall data (specific behaviors pooled) can be viewed

under these conditions. In addition several other different within interaction analyses can be performed. For example, several sequence analyses are possible, two such are (1) which actor--caretaker or infant--reinforces an initiated behavior; (2) length of actor changes, for example, caretaker-infant-caretaker vocalizations would constitute a three chain while caretaker-infant vocalizations would constitute only a two chain.

Results

Developmental Changes

Table 2 presents the mean specific and overall behavior frequencies per minute of observation, for caretakers and for infants, for interactive, non-interactive and both conditions combined (total).

Insert Table 2 about here

For infants overall behavior frequencies, for both conditions combined, increased with increases in age of the infant (rho = .73, $p < .01$). There was no significant increase in overall caretaker behavior, for both conditions combined, with increased age of child (rho = .27). However, when the amount of caretaker behavior was observed separately during interaction and noninteraction conditions, significant relationships with the age of the infant appeared (rho = .73, $p < .01$, during interaction; rho = -.60, $p < .05$, during non-interaction).

Insert Table 3 about here

The second analysis observed the specific behavioral categories. This analysis utilized relative frequency data, that is, specific behavior frequency divided by the overall behavior frequency. The results within interaction indicated changes in the dominant behavior of both caretakers and infants according to age of infant. For infants, the switch may be characterized as a change from passive-reflexive behaviors at younger ages to more active behaviors at older ages, that is, crying and looking decreased over age while vocalizing, touching and smiling increased (see Table 3). For caretakers, the switch in behavior dominance may be characterized as a change from proximal to more distal behavior; "touch gross" and "fine" decreased while "vocalizing" and "smiling" increased (see Table 3). These trends were in general consistent for both interactive and noninteractive conditions.

Insert Table 4 about here

A second age difference has to do with sequences and therefore is limited to the interaction condition. The first sequence dimension observed was reinforcement behaviors, that is, who responded to whom (see Table 4). The degree of reinforcement of infant behaviors by the caretakers was not related to age of infant, but the reinforcement of caretaker behaviors by infants does appear to be related to the age of the infant with older infants doing more reinforcing. This was true for each specific kind of behavior (rhos vary from .40 to .49) and was significant across overall behaviors (rho = .63, $p < .02$). Another sequence dimension observed was the number of actor-changes. The data reveal that the number of actor-changes per sequence was significantly related to infant age (two chain sequences, rho = .21; three chain, rho = .60, $p < .02$;

four chain, rho = .58, $p < .02$; longer chains, rho = .75, $p < .005$). These data indicate that for each chain length older infants showed greater numbers of chains and demonstrated longer interactive sequences.

Individual Differences

No sex differences nor birth order effects were found. Moreover, no economic class differences nor family size differences were found. Finally, there were no differences that would be related to the age of the caretaker in terms of amount and nature of his behavior toward the infant.

Cognitive Growth and Its Relationship to Infant/Caretaker Behavior

Mental Development Index (MDI) scores were computed from the raw scores obtained on the Cognitive Scale of the new Bayley Scales of Infant Development. A score of 100 is said to be average and the scorable limit is 150. Nine of the ten infants tested had MDI scores over 100; two had scores of 140, six had scores around 130 and one had a score of 111. The tenth infant's score was 90. On the average, the infants in the sample obtained scores appropriate for infants 1-1/4 months older than their own age level.

Psychomotor Development Index (PDI) scores were computed from raw scores on the Motor Scale of the new Bayley Scale of Infant Development. A score of 150 again represents the limit of the scale; six of the ten infants tested above the limit. Two of the remaining four infants received scores over 130; the remaining two represented "normal" scores, 98 and 108. On the average, the infants in this sample obtained scores appropriate for infants two months in advance of their own age level. There was no significant correlation between the scores obtained on the PDI Scale and those obtained on the MDI Scale.

While these infants showed precocious development compared to American infants on both the MDI and PDI, there were no relationships of either MDI or

PDI scores and any of the interaction measures or demographic variables.

Discussion

As is often the case with the study of unusual populations, the sample size obtained was small. While significant results with a small sample indicate a powerful effect, the ability to generalize from these findings must await the study of diverse and larger samples. With this in mind, several interesting findings of the study will be discussed.

The most important result to emerge was that the pattern of caretaker-infant interaction was related more strongly to the age of the infant than any other variable investigated. As would be expected, amount of infant behavior, both in interaction and noninteraction conditions increased with age. Recorded caretaker behaviors also increased with the age of the infant when those behaviors were directed toward the infant while noninteractive behaviors decreased with the age of the infant.

In terms of specific types of behaviors, it was found that as infants became older their behavior changed from predominantly passive-reflexive forms of behavior to more active-operant forms; maternal behavior changed from predominantly proximal to predominantly distal forms of behavior. This agrees with other American studies which found a similar switch from proximal to distal behaviors as infants became older (Lewis & Ban, 1971; Moss, 1965). Moreover, as infants become older, interaction becomes both more frequent and more varied in terms of actor-change.

The sample was so unevenly distributed between the sexes that little comment can be made on the lack of differences found. However, as Goldberg (1969) has also failed to find sex differences among African infants, there is reason

to believe that sex role differentiation may occur later for some African infants than for American or European infants. If this is the case, it may be possible to examine the effects of differential timing in sex role development through cross-cultural studies.

The lack of differences associated with economic class was not surprising. Differences in economic class were evident chiefly in areas of modernization--the presence of modern conveniences and the higher level of modern education for the fathers of the higher class ("Group A" in Table 1). However, there was no corresponding difference in educational level among mothers, and the modern conveniences (indoor water supply and sanitary system, ownership of a car by the husband) are apparently not used in a way which would provide women with more (or less) time for their infants. An alternate reason for the lack of economic class differences lies in the possibility that class differences of the kind found in America have their principal effect on family life, not in economic matters, but rather in different philosophies of childrearing. In Senegal, outside of metropolitan Dakar, the population is probably not differentiated enough to possess widely different philosophies.

Another finding is the lack of relationship of interaction patterns to age of caretaker or to the relationship of caretaker to child. It is surprising that it should make little difference in either treatment of the infant or infant response to this treatment, whether the caretaker is 7 or 70 years old or whether she is his natural mother, his mother's mother, his sister, or his distant cousin. There has been considerable speculation in the literature about the effects of multiple mothering (see Yarrow, 1961). Some evidence has been presented (Brackbill, 1962; Rabin, 1958) indicating that no damaging effects result from this condition. The data therefore lead one to suspect that cultural

phenomena account for this lack of effect, and that similar results would be found wherever the extended family and early participation of children in family activities is customary.

The results of the developmental testing is in agreement with other findings of precocious infant development. In light of the wide acceptance of the view that maternal stimulation affects infant development (Hunt, 1963), the lack of relationship between any of the interaction measures and the motor and cognitive scores on the Bayley Scales is puzzling. This finding may be explained by the small sample size or by the small variance of the interaction motor and cognitive measures. There is, however, another possible conclusion concerning the failure of the interaction measures to differentiate the more developmentally advanced infants from the less advanced. Gebér's (1957b, 1960) finding of precocity in African newborns, together with her findings of the continuation after birth of precocity in infants raised traditionally and the loss of precocity in infants of highly acculturated families, may be interpreted in the following manner: Either genetic factors or maternal practices during pregnancy may account for the precocity found in the newborn. Traditional child care practices after birth may not accelerate precocious development, but rather maintain it, while more westernized child care practices may retard this growth in the first year of life. If the stimulation available in traditional homes played this maintenance role, then the failure of interaction measures to discriminate the relatively more from relatively less advanced infants might be more understandable. However, the lack of relationship between caretaker-infant interaction and measures of infant functioning are still puzzling.

Gebér (1958a, 1958b) has found that African infants appear to lose their accelerated developmental standing if they continue to be raised in the

traditional environment after two years, but attendance at nursery school maintains this rate (and brings infants raised by westernized methods up to a normal pace of development). In the light of these results, two further speculations may be ventured: (1) nutritional factors may retard the traditionally raised infant after two years of life (when mother's milk is no longer nutritionally adequate and food supplement may be too low in protein); or (2) development in the first year of life may be enhanced--or advanced development permitted to continue--by kinds of stimulation available in the traditional infant environment, while stimulation of a different nature is required for further development at the same rate in later years. Further research concerning the effects of nutritional differences, differential presence of toys for the first year of life, and the effects of maternal practices during pregnancy on newborn state of development is needed in order to explore these alternative hypotheses.

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Footnote

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Table 1

Demographic Data for Each Subject

Name	Sex	Age in mos.	Birth Order	Household Size	No. Wives	No. of Caretakers	Economic Group[1]	Father's Occupation
DD	F	9.5	3	7	1	3	A	High School Principal
DA	M	6.9	7	8	2	3	B	Potato Merchant
GB	M	3.1	2	15	2	3	A	Director Cultural Center
NC	M	2.1	3 (twin)	13	1	3	B	Sculptor and Merchant
NX	F	2.1	(twin)	13	1	3	B	Sculptor and Merchant
NE	M	4.8	1	7	1	2	A	High School Gym Teacher
SA	M	4.0	4 (twin)	8	1	3	B	Jeweler
SUA	M	11.1	8	13	2	4	A	Youth Group Director
TB	M	3.5	4	15	2	3	A	Primary School Director
TD	F	12.3	6	15	2	3	A	Primary School Director

[1]Group A lived in stone houses which they used for daily activities, had refrigerators and indoor water supply.

Group B lived in smaller stone houses but carried on most daily activities outside of them in courtyard; had no refrigerator, and their water supply was from a public well.

Table 2

Individual Infant and Caretakers Mean Frequencies per Minute of Observation for Each Behavior Category and Overall Behavior as a Function of Interaction, Noninteraction and Total Behavior Frequency

		Infants							Caretaker					
Name		Fret/cry	Extreme Movement	Look (at person)	Vocalize	Smile	Touch (a person)	Overall Average	Touch gross	Touch fine	Vocalize	Smile	Approach	Overall Average
NC	Interaction	.46	.08	.35	.04	0	.04	0.16	.35	.46	.38	.04	0	0.25
	Noninteraction	.19	0	.15	0	0	0	0.06	.73	.42	.27	0	0	0.28
	Total	.65	.08	.50	.04	0	.04	0.22	1.08	.88	.65	.04	0	0.53
NX	Interaction	.59	.07	.18	.04	.04	0	0.15	.38	.52	.30	.02	.04	0.25
	Noninteraction	.18	.18	.07	.07	0	.02	0.09	.84	.70	.68	.05	.07	0.47
	Total	.77	.25	.25	.11	.04	.02	0.24	1.21	1.21	.98	.07	.11	0.72
GM	Interaction	.34	.04	.40	.14	.14	.10	0.19	.64	.58	.44	.06	.02	0.35
	Noninteraction	.14	.14	.14	.06	.02	.08	0.10	.58	.50	.26	.02	.02	0.27
	Total	.48	.18	.54	.20	.16	.18	0.29	1.22	1.08	.70	.08	.04	0.62
TB	Interaction	.02	.29	.20	.23	.04	0	0.13	.18	.34	.26	0	0	0.16
	Noninteraction	.13	.84	.13	.45	0	.13	0.28	.11	.16	.04	0	0	0.06
	Total	.14	1.13	.32	.68	.04	.13	0.41	.29	.50	.30	0	0	0.22
SA	Interaction	.45	.30	.38	.17	.03	.55	0.31	.90	.53	.43	.10	.05	0.40
	Noninteraction	.13	.22	.25	.17	0	.38	0.19	.33	.22	.12	.02	.02	0.14
	Total	.58	.52	.63	.33	.03	.93	0.51	1.23	.75	.55	.12	.07	0.54
NE	Interaction	.55	.45	.55	1.90	.45	.60	0.75	.45	.95	2.43	.23	.08	0.83
	Noninteraction	.15	.63	.05	.80	.08	.13	0.31	.35	.43	.48	0	.02	0.26
	Total	.70	1.08	.60	2.70	.53	.73	1.06	.80	1.38	2.90	.23	.10	1.08
DA	Interaction	.60	.24	.38	.29	.19	.33	0.34	.38	.47	.74	.10	.02	0.34
	Noninteraction	.22	.10	.03	.21	.05	.31	0.15	.19	.26	.12	0	0	0.12
	Total	.83	.34	.41	.50	.24	.64	0.49	.57	.72	.86	.10	.02	0.46
DD	Interaction	.02	.61	.43	2.77	.27	.30	0.73	.63	.32	1.75	.14	.04	0.58
	Noninteraction	0	.41	.05	4.84	.09	.63	1.00	.37	.27	.54	.04	0	0.24
	Total	.02	1.02	.48	7.61	.36	.93	1.74	1.00	.59	2.29	.18	.04	0.82
SUA	Interaction	.02	.55	.97	1.66	.74	.15	0.68	.10	.29	2.03	.44	.02	0.58
	Noninteraction	.04	1.10	.53	1.63	.26	.23	0.63	.08	.06	.44	.04	0	0.12
	Total	.06	1.65	1.50	3.29	.98	.37	1.31	.18	.35	2.47	.48	.02	0.70
TD	Interaction	.37	.55	.73	1.32	.20	.13	0.55	.42	.40	2.53	.15	.02	0.70
	Noninteraction	.28	.57	.40	.58	.07	.18	0.35	.10	.10	.35	.03	.10	0.14
	Total	.65	1.12	1.13	1.90	.27	.32	0.90	.52	.50	2.88	.18	.12	0.84

Table 3

Correlations of Relative Frequency of Infants' and Caretakers' Behaviors with the Age of the Infant within Interaction

Infant	rho	p	Caretaker	rho	p
Fret/cry	-.49	.10	Touch, gross	-.64	.01
Extr. movement	.23	NS	Touch, fine	-.60	.02
Look	-.25	NS	Vocalize	.64	.02
Vocalize	.63	.02	Smile	.64	.02
Smile	.37	NS	Approach	.07	NS
Touch	.20	NS			

Table 4

Correlations of Reinforced Individual Behavior Frequency with Age of Subjects, both for Infants and Caretakers

Infant			Caretakers		
Percent reinforced by Caretaker of specific behavior:	rho	p	Percent reinforced by Infant of specific behavior:	rho	p
Fret/cry	-.07	NS	Touch, gross	.49	.10
Extr. movement	.14	NS	Touch, fine	.40	NS
Look	.11	NS	Vocalize	.47	.08
Vocalize	-.02	NS	Smile	.42	NS
Smile	-.18	NS	Approach	.40	NS
Touch	.14	NS			
Overall	-.25	NS	Overall	.63	.02